



Armed Forces College of Medicine AFCM



Histological Structure of Arteries

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INTENDED LEARNING OBJECTIVES (ILO)



:By the end of this lecture the student will be able to

1. Describe the histological structure of the aorta, medium-sized artery, arteriole, metarteriole and arteriovenous shunts.
2. Correlate the histological structure of the aorta, medium-sized artery, arteriole, metarteriole and arteriovenous shunts to their functions.
3. Interpret the altered microscopic structure of arteries in different diseases

Key points of this lecture



1. General histological structure of the blood vessels.
2. Histological structure of aorta as an example of large elastic artery & its clinical correlation.
3. Histological structure of medium-sized arteries and its clinical correlation.
4. Histological structure of arterioles and metarterioles.

The vascular system



- It is a circuit which distributes blood to and from all organs and tissues.

Arteries

Transport blood away from the heart to capillaries

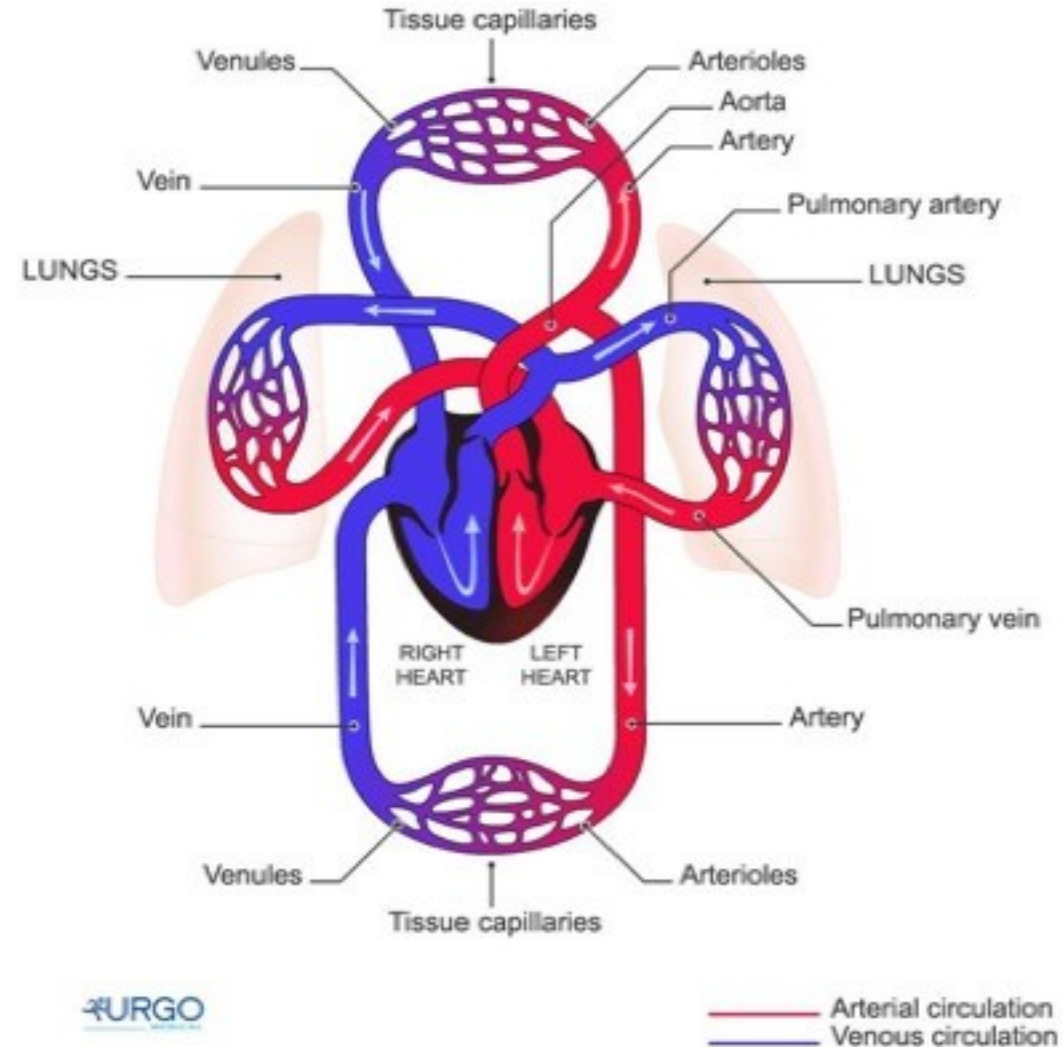
Veins

Return blood back to the heart

New Five Year Program

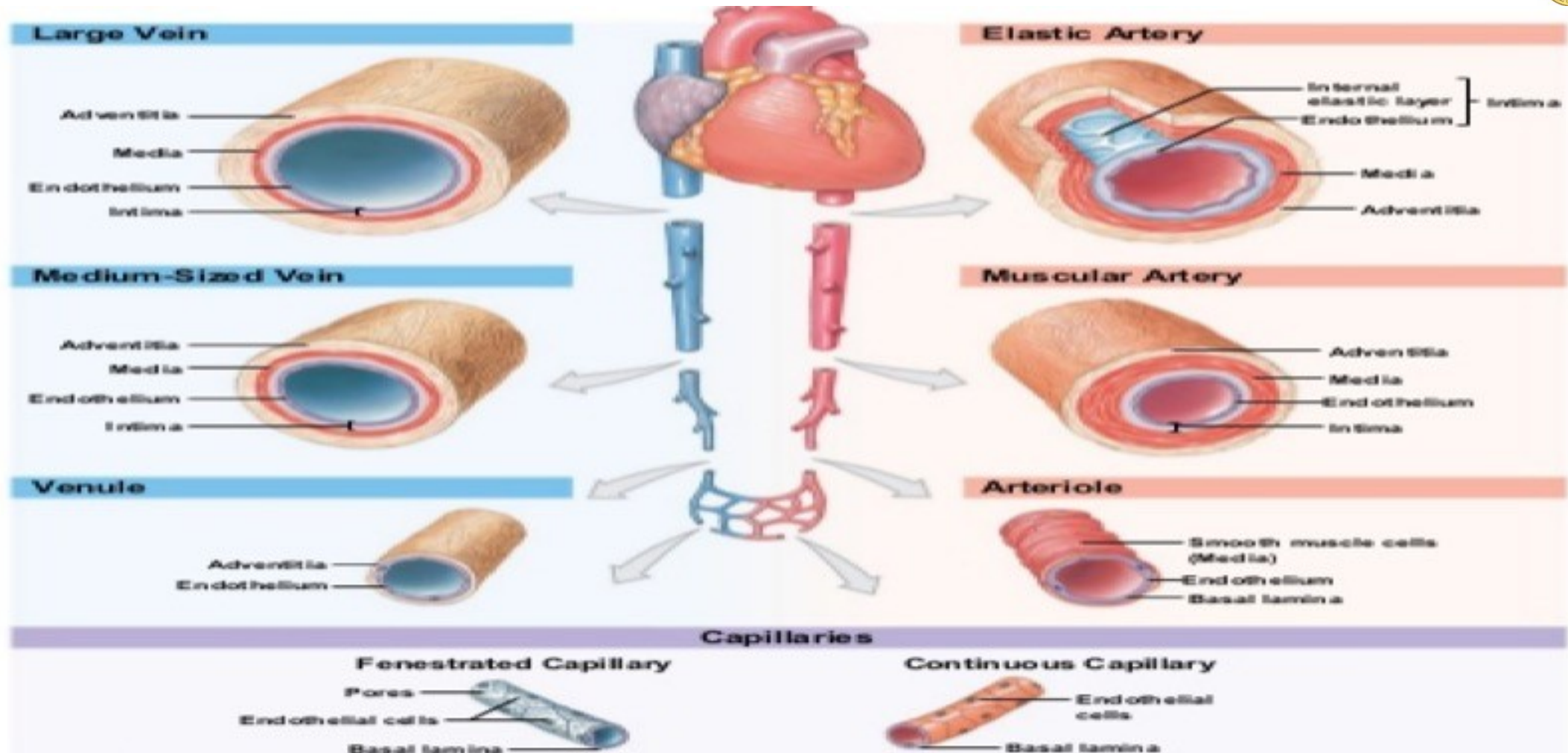
Capillaries

Thin walled vessels, site of exchange of gases, nutrients, waste products and hormones



MURGO

http://sphweb.bumc.bu.edu/otlt/mph-modules/ph/ph709_heart/CardiovascularS





Generally, the wall of blood vessels is composed of three concentric layers:

Tunica Intima:

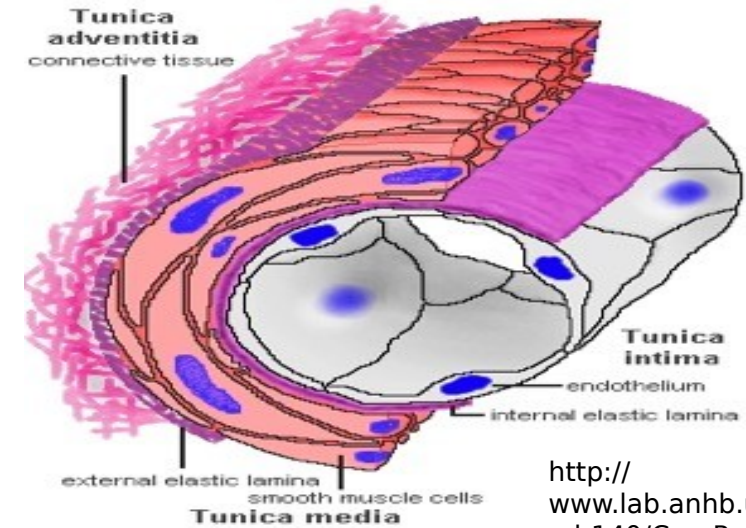
Innermost layer that faces the lumen.

Tunica Media:

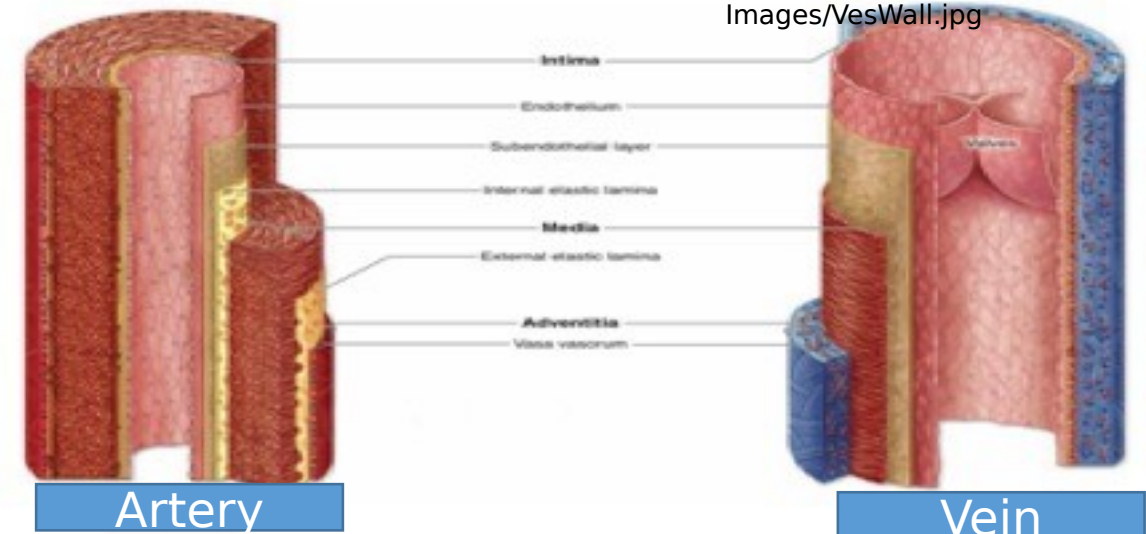
Middle layer, most prominent in arteries.

Tunica Adventitia:

Outermost layer, prominent in veins.



<http://www.lab.anhb.uwa.edu.au/mb140/CorePages/Vascular/Images/VesWall.jpg>



Tunica Intima



Composed of the following structures:

A- Endothelium:

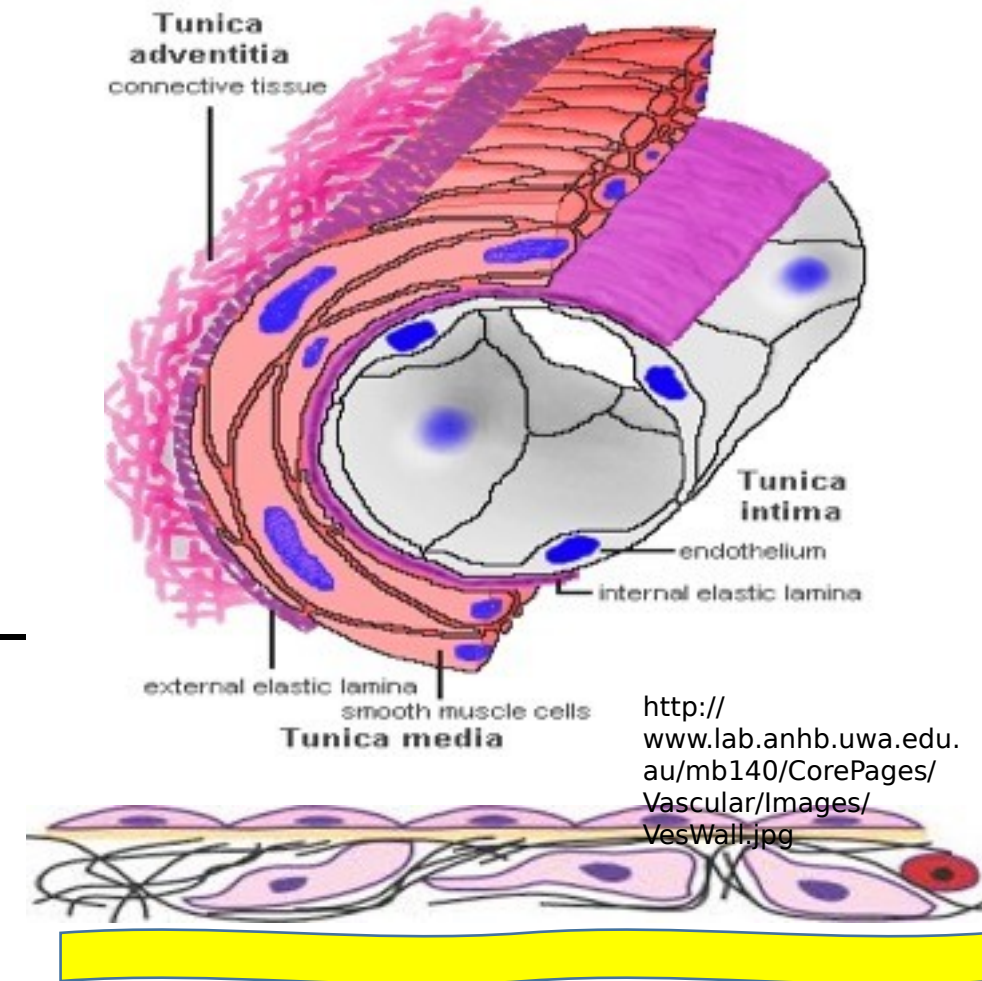
- Simple squamous epithelium resting on basal lamina.
- Provides smooth surface for blood flow.

B - Subendothelial CT:

Loose CT- few smooth muscle fibers – elastic fibers.

C- Internal elastic lamina:

- **Fenestrated** sheet of elastin.
- To allow diffusion of substances to deeper layers.

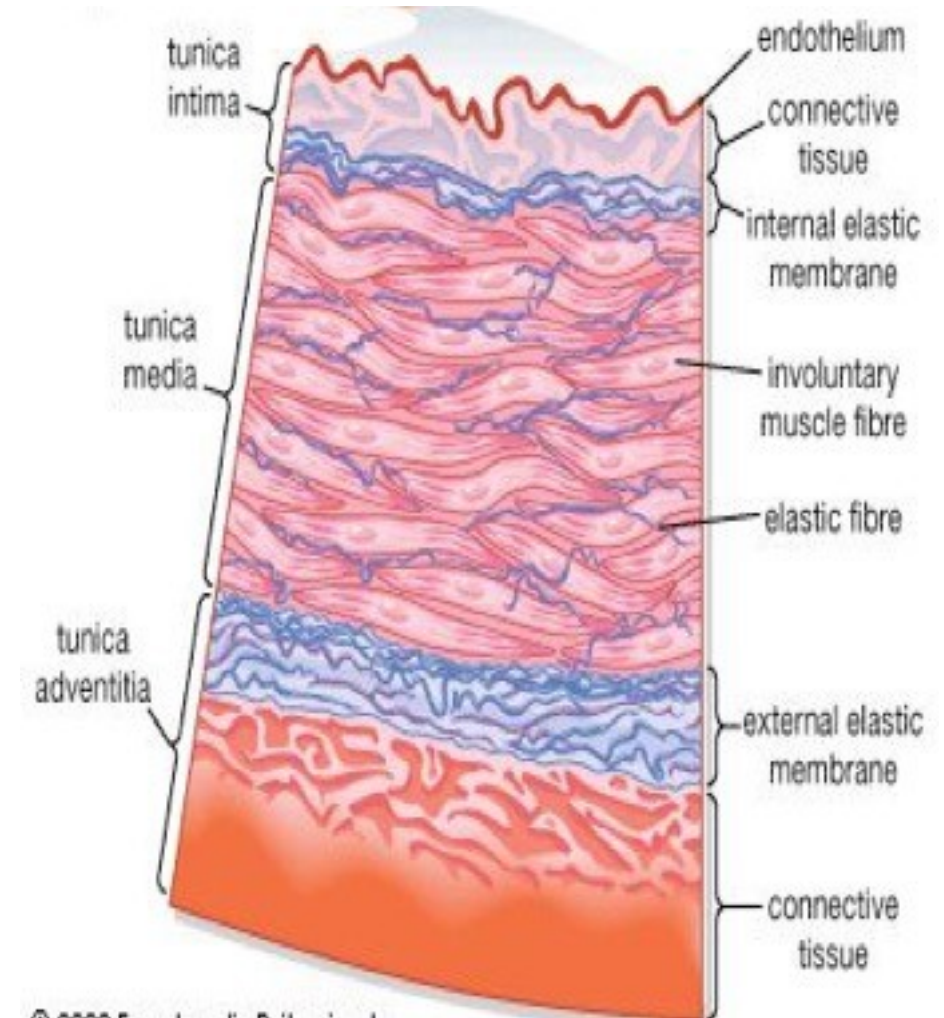


Tunica Media



Composed of:

- **Smooth muscles:** concentric layers of smooth m.fs. (No fibroblasts)
- **Elastic fibers - collagen type III** (reticular fs)
- **External elastic lamina (EEL):** **Fenestrated** sheet of elastin that separates T. media from T.

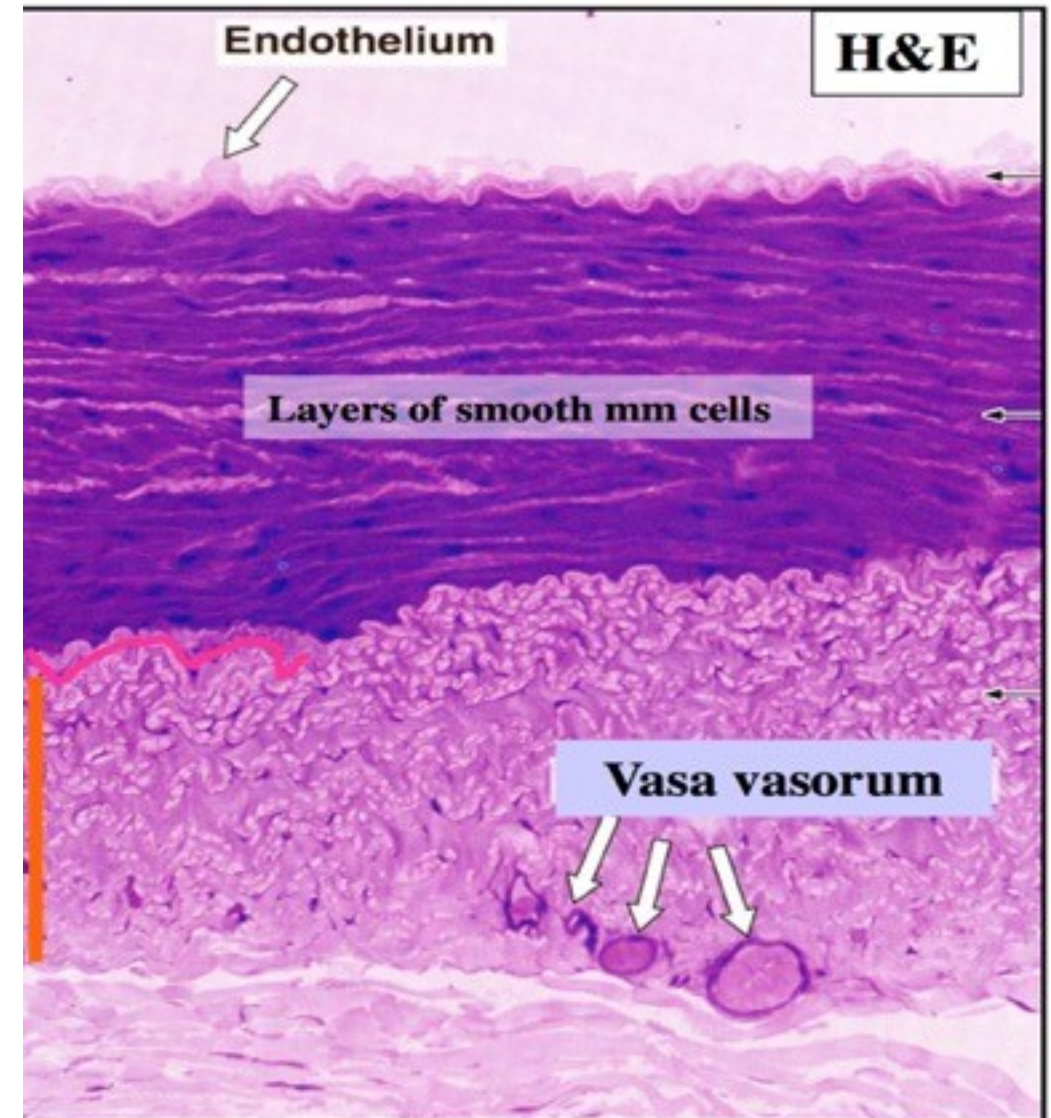


<https://cdn.britannica.com/16/55016-050-3AE7EA6E/section-artery.jpg>

Tunica Adventitia



- **Composed of:**
- **Fibro-elastic CT:** fibroblasts- collagen I and elastic fibers.
- **Vasa vasorum:** arteries that enter the vessel wall and branch to supply adventitia & T. media with oxygen and nutrients.
- More numerous in veins (as they contain deoxygenated blood)





QUIZ



List the layers of a blood vessel in order, and enumerate their constituents

Tunica intima



- 1- Endothelium.
- 2- Subendothelial c.t.
- 3- IEL

Tunica media



- 1- Smooth muscle fibers.
- 2- Elastic fibers.
- 3- EEL

Tunica adventitia



- 1- Fibroelastic c.t.
- 2- Vasa vasorum
- 3- Nervi vascularis

Arteries



Arteries are classified into 3 major types:

- 1- Elastic (conducting) arteries. (*Transmit blood to smaller arteries*).
- 2- Muscular (distributing or medium sized) arteries. (*Transmit blood to organs*).
- 3- Arterioles. (*Transmit blood within the organ*).

Elastic arteries (Conducting arteries)



Examples: Aorta, and pulmonary artery and their large branches.

Structure:

- Wide lumen, thick wall
- Formed of the three tunicae:

T. Intima:

A- Endothelium:
simple squamous cells
with tight J.

**B- Subendothelial
CT**

**C- Internal elastic
lamina**

T. Media:

- Thickest layer. Consists of:
- **50 fenestrated elastic sheets.**
(main constituent)
- **Smooth muscle cells:**
few fibers

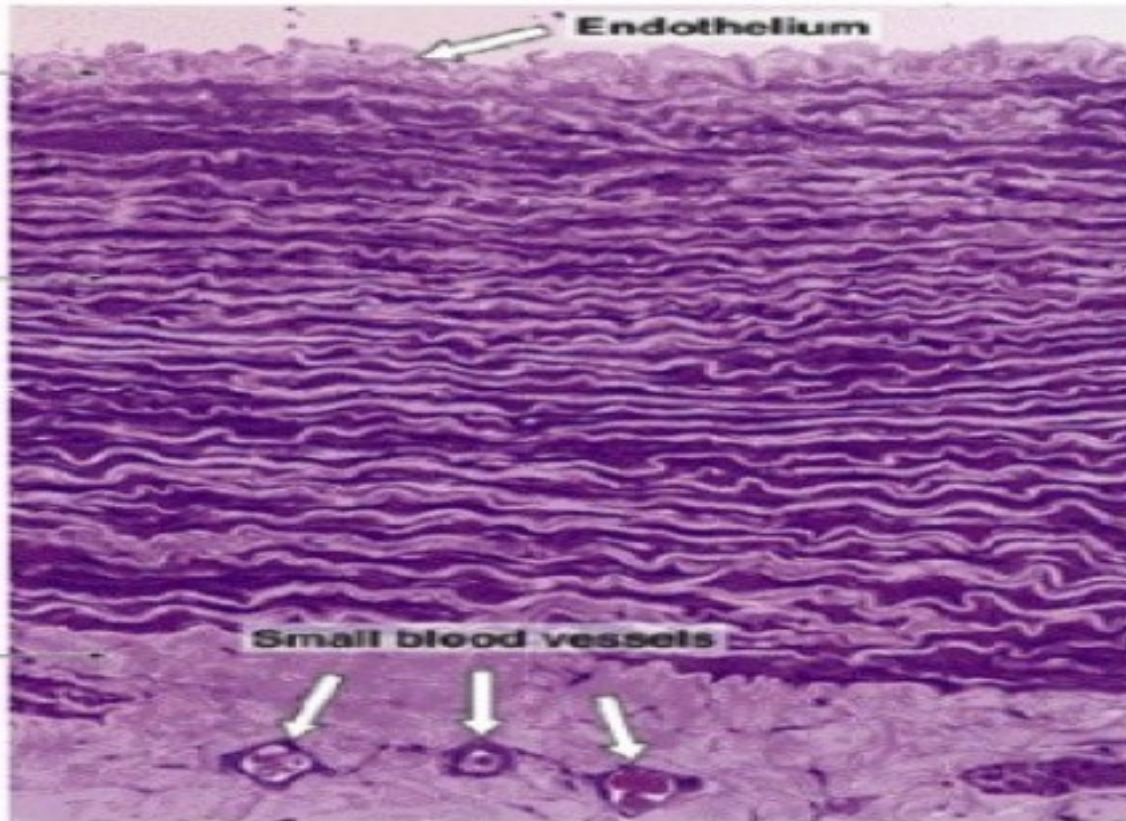
T. Adventitia

- :
- Thin layer.
See before

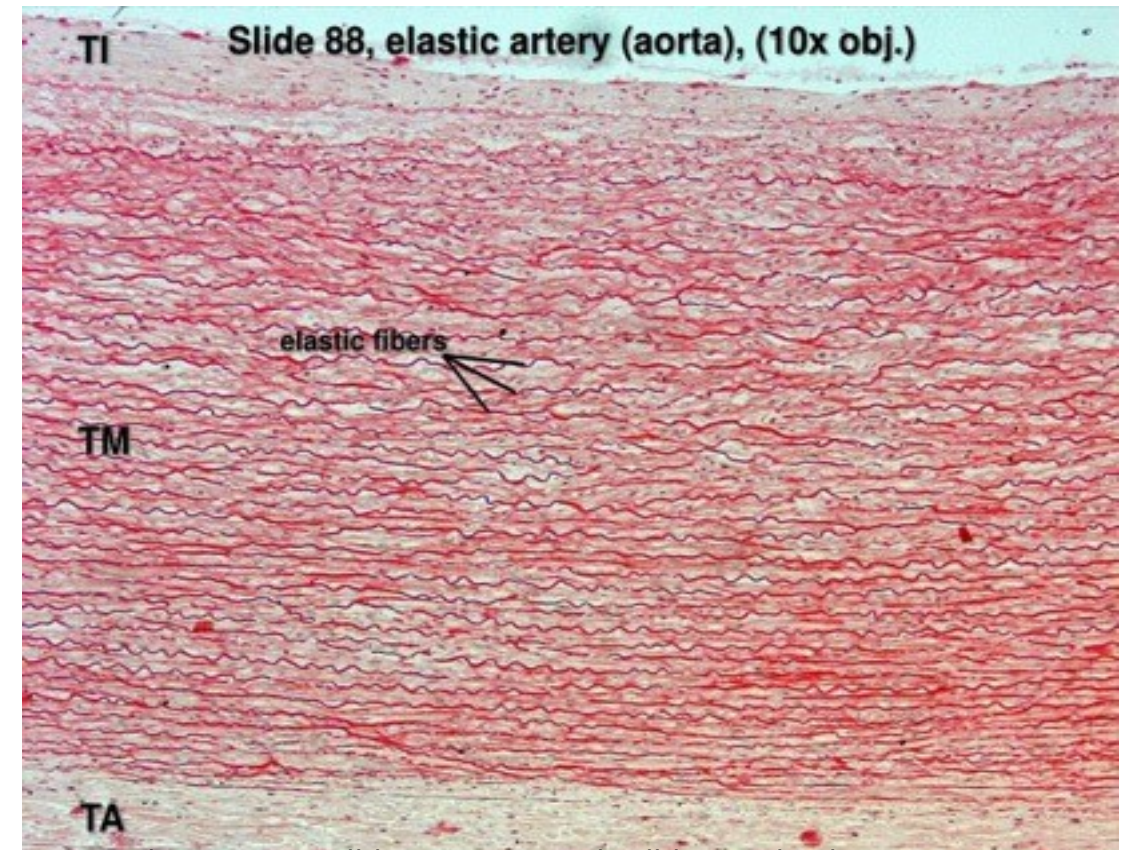


https://undergraduate.vetmed.wsu.edu/images/librariesprovider8/VPh308/wsu_1_074_full.jpg?sfvrsn=4ee21938_2

Elastic arteries



<https://images.slideshow1.com/23/6595094/slides/>



<https://www.slideserve.com/asis/slide-88-elastic-artery-aorta-10x-obj>

Functions:

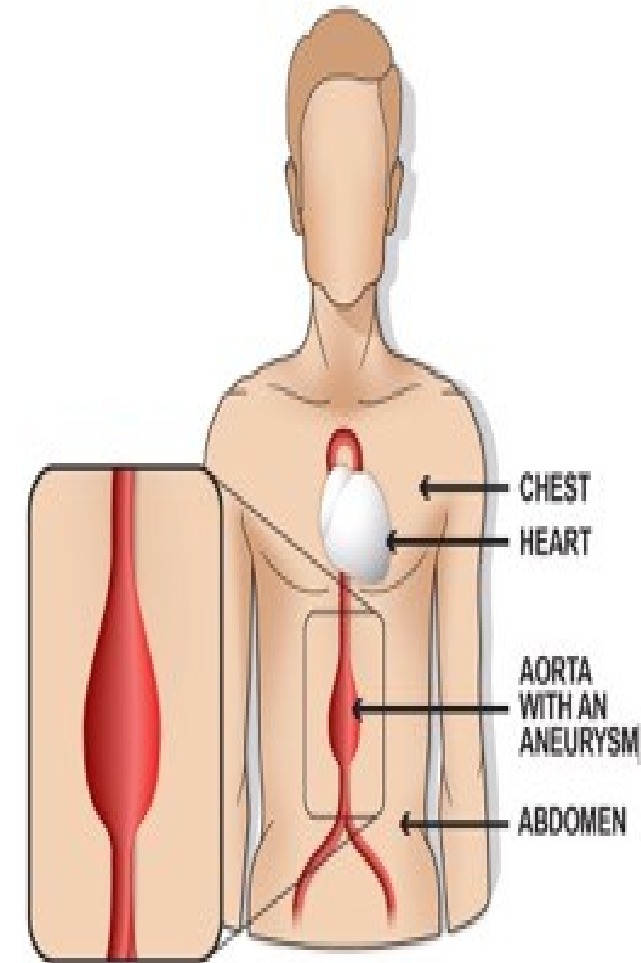
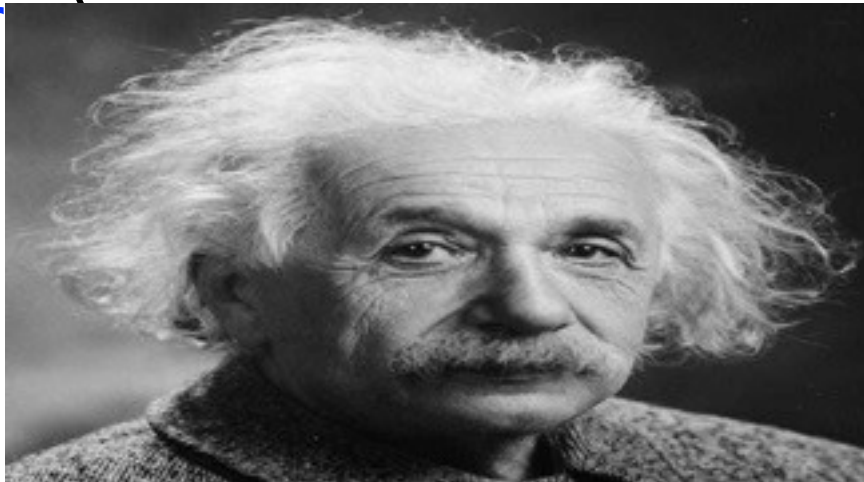
- 1- Conducting blood away from the heart.
- 2- Minimize changes in pressure during systole and diastole. How?

Clinical correlation



Aneurysm

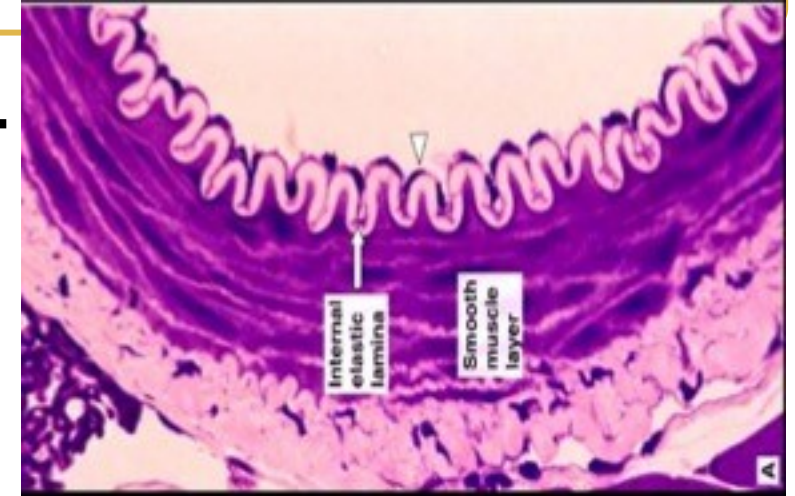
A sac like dilatation of the arterial wall resulting from weakness of the vessel wall, and is usually age-related (at sites of **atheromatous plaques**, or due to **gene mutation in fibrillin of elastic fibers**).



Muscular arteries (Distributing, medium-sized arteries)

Examples: Femoral, ulnar, radial arteries..

Structure: Narrow lumen, thick wall
Formed of the three tunicae:



<https://image.slidesharecdn.com/sistemulcardiovascular-130220093233-phpapp02/95/cardiovascular-system-histology-5-638.jpg?cb=1361353540>

T. Intima:

A- Endothelium:

simple squamous cells with tight J.

B- Subendothelial CT

C- Prominent internal elastic

T. Media:

- Smooth muscle cells.

(Main

constituent)

- Few elastic fibers

- Prominent EEL

T.

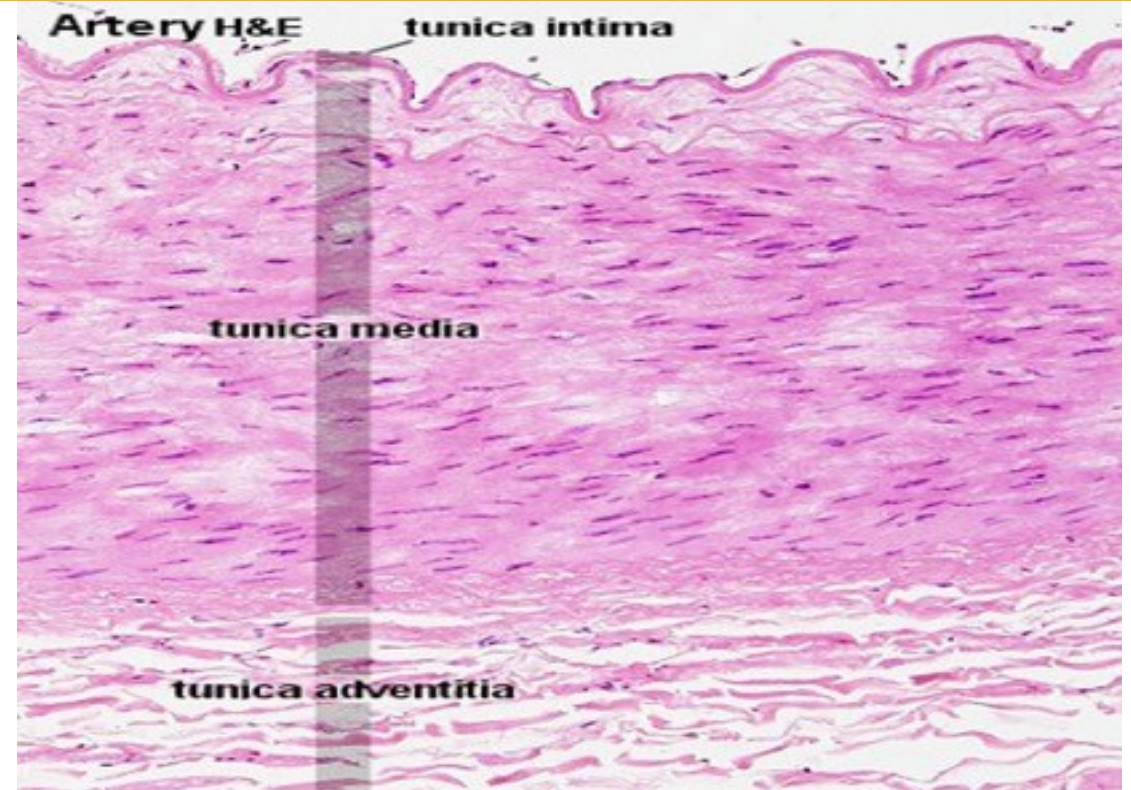
Adventitia

:

-Thin layer.

See before

Muscular arteries



<https://www.sciencesource.com/Folder/2OPEBMAF2WLV#/SearchResult&STID=2OPEBMAF2WLV&VBID=2OPES67EZR9M&POPUPPN=35&POP>

<http://koorla.com/#img>

Function:

- blood flow to different parts of the body.

N.B: The smooth muscles in the media are supplied with and under control of autonomic nervous system.

Clinical correlation

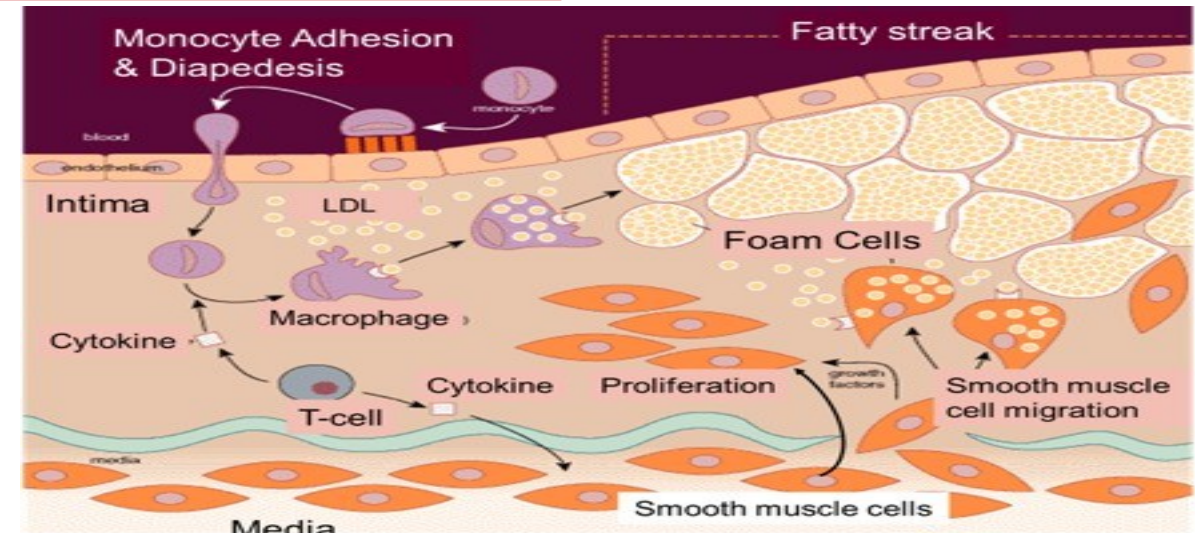


Atherosclerosis

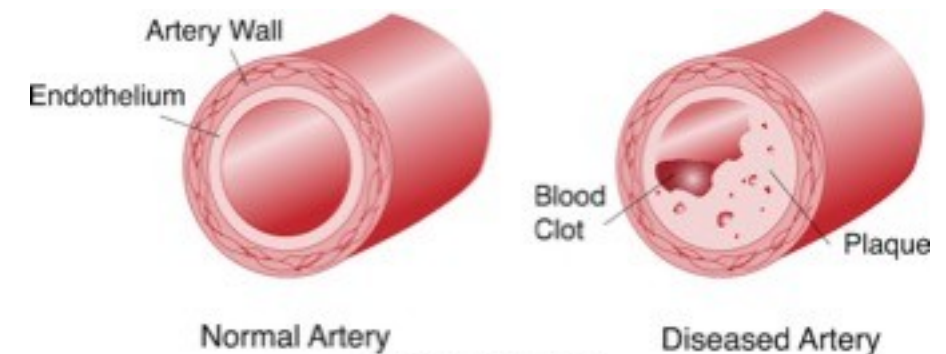
- It is a thickening and hardening of both elastic and large muscular arteries.

- The initial event resulting from high circulating levels of LDL is **damage of arterial endothelium.**

- Leads to formation of **atherosclerotic plaques** containing **lipid-filled**



http://sphweb.bumc.bu.edu/otlt/mph-modules/ph/ph709_heart/FattyStreak2.png



<https://image.shutterstock.com/image-vector/diseased-artery-plaque-compared-healthy-260nw-1130351360.jpg>

Arterioles



- Lumen diameter less than 0.1 mm.
- **Structure:** Narrow lumen, thin wall

T. Intima:

A- Endothelium:

simple squamous cells with tight J.

B- Thin

Subendothelial CT

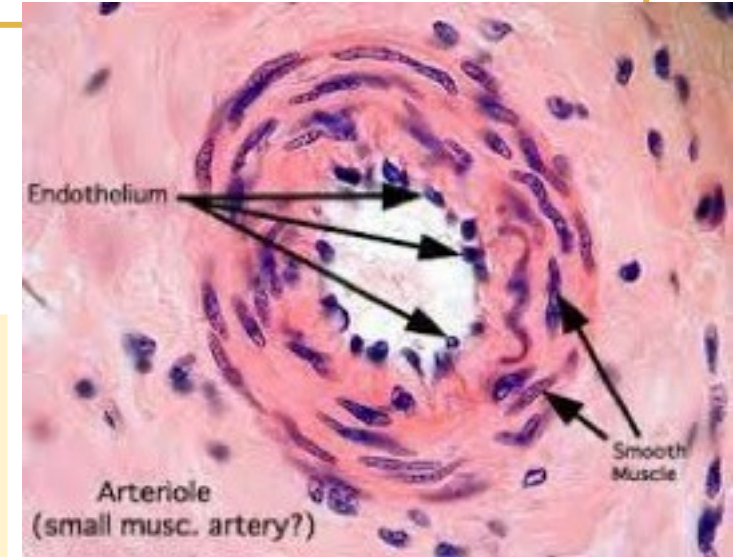
C- Internal elastic lamina; present only

Function: Regulate blood flow to the capillary bed....major determinant of **diastolic** blood pressure (Muscle tone normally keeps arterioles partially closed, resisting blood flow)

• *Dilation of the arterioles decreases diastolic blood pressure, while constriction of the*

T. Media:

- Thin layer.
- Formed of **2-3 layers of smooth muscle cells in large arterioles**
- **No EEL**



<https://quizlet.com/59322247/yy-flash-cards/>

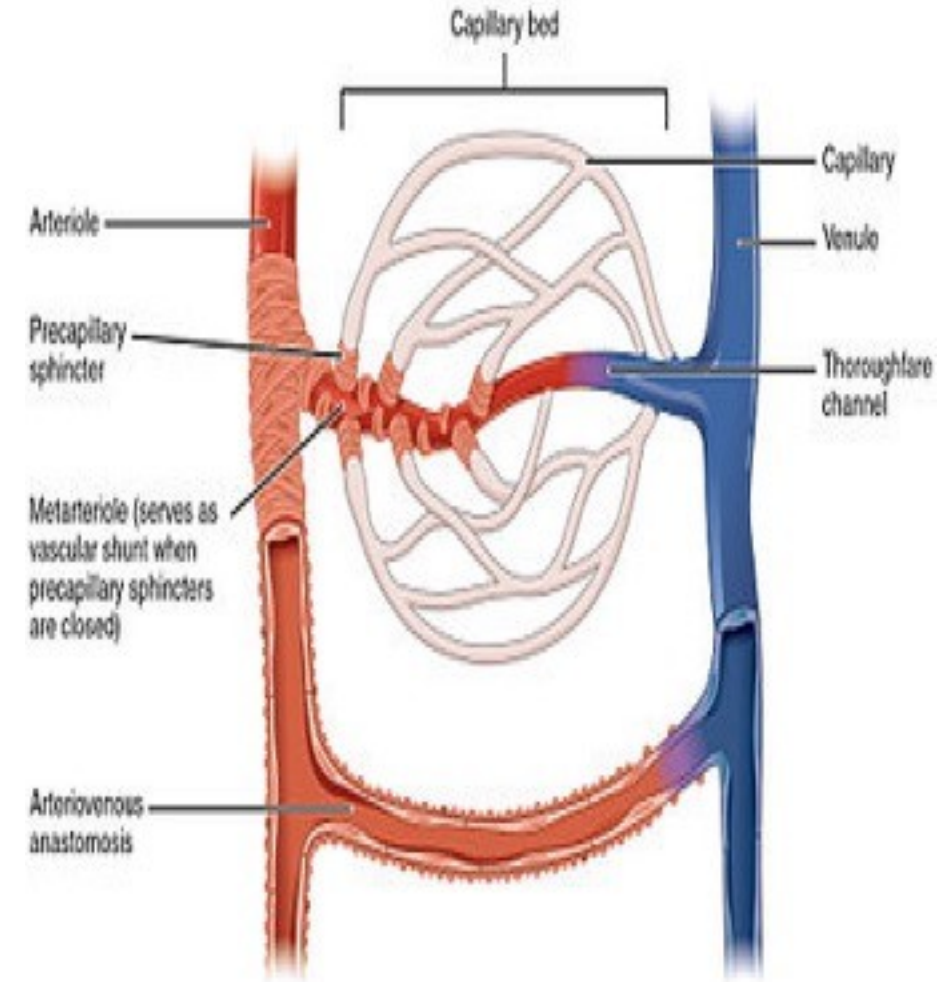
T. Adventitia:

-Very thin layer.
See before

Metarterioles



- These are small arterioles that supply blood directly to capillary beds.
- In the **tunica media**; there are separated smooth muscle cells, each act as a sphincter (**precapillary sphincter**) → control blood flow to the capillaries.



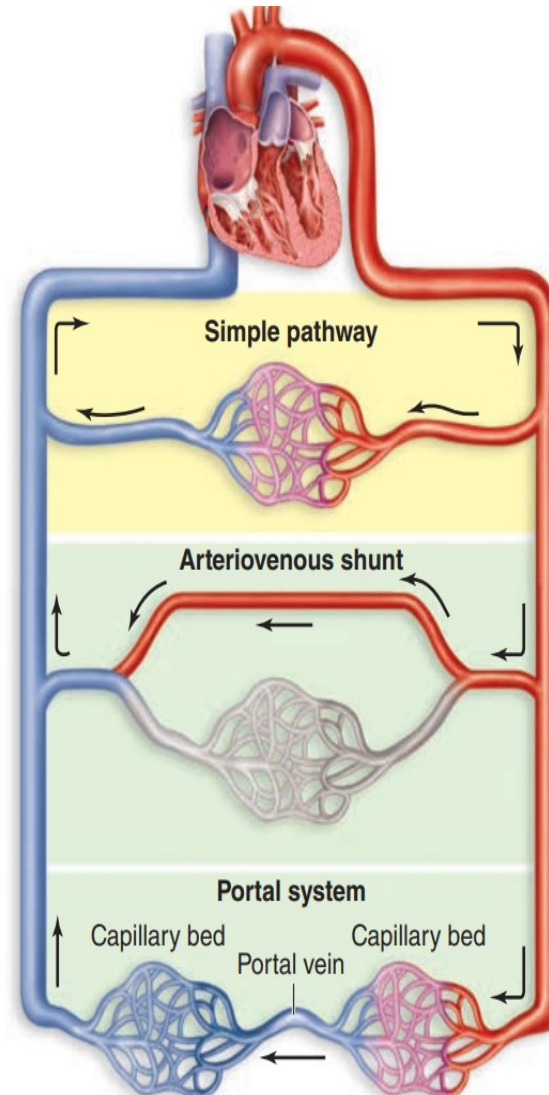
https://upload.wikimedia.org/wikipedia/commons/thumb/4/49/2105_Capillary_Bed.jpg/400px-2105_Capillary_Bed.jpg

Alternative microvascular pathways



1 - The portal system

- 2 successive capillary beds separated by a portal vein.
- For delivery of hormones or nutrients.
- In liver, pituitary



<https://accessphysiotherapy.mhmedical.com/>

2- Arterio-venous anastomosis (A-V- Shunts)

- Direct connections between arterioles and venules, bypassing the capillary bed.
- Numerous in skin of fingertips and nose
- Thermoregulation at the body surface

Summary



Metarteriole	Arteriole	Muscular artery	Elastic artery	
<ul style="list-style-type: none"> --Endothelium -Very thin subendothelial c.t. 	<ul style="list-style-type: none"> -Endothelium -Thin Subendothelial c.t. 	<ul style="list-style-type: none"> -Endothelium -Subendothelial c.t. -Thick IEL 	<ul style="list-style-type: none"> -Endothelium -Subendothelial c.t. with smooth muscles - IEL 	<u>T. Intima</u>
<ul style="list-style-type: none"> -Separated individual smooth muscle cells. <p>(precapillary sphincter)</p>	<ul style="list-style-type: none"> -2-3 layers of smooth muscle cells 	<ul style="list-style-type: none"> -Numerous smooth muscle cells -Elastic fibers -Thick EEL 	<ul style="list-style-type: none"> -Numerous fenestrated elastic sheets (lamellae). - Smooth muscle cells - EEL 	<u>T. Media</u>
<ul style="list-style-type: none"> -Sparse loose CT 	<ul style="list-style-type: none"> -very thin 	<ul style="list-style-type: none"> -Relatively thick fibroelastic layer. 	<ul style="list-style-type: none"> -Thin fibroelastic layer. -Vasa vasorum 	<u>T. Adventitia</u>

Question 1



In which blood vessel the Internal elastic lamina is prominent ?

- A. Elastic arteries
- B. Distributing arteries
- C. Medium-sized veins
- D. Metarterioles

Question 2



Which blood vessel contains thick media with prominent fenestrated elastic membranes ?

- A. Muscular artery
- B. Inferior vena cava
- C. Aorta
- D. Continuous capillary

Suggested textbooks



1- Junqueira`s Basic Histology; Text and Atlas. 14th edition 2016, pp: 219-223.

2- Histology atlas and test: Michael H. Ross and Wojciech Pawlina, 7th edition, 2015, pp: 411-422



**Thank
You**

Mahalo

Kiitos

Tack

Grazie

Toda

Obrigado

Takk

Thanks

Gracias

Merci